

Fukushima Daiichi Nuclear Power Station

Start of the Marine Organisms Rearing Tests (1/2)

<Reference Material>

September 29, 2022

TEPCO Holdings

Fukushima Daiichi D&D Engineering Company

- In order to alleviate people's concerns and to cultivate peace of mind, we will rear marine organisms in tanks of seawater containing ALPS treated water and compare them with organism reared in normal seawater and report the results carefully in an easy-to-understand manner.
- Based on the results of many studies domestic and abroad on the behavior of tritium, data for this test will first be gathered for 6 months to show that "tritium is not concentrated in the living bodies and that the concentration of tritium in live bodies does not exceed that of the rearing environment" as demonstrated in past tests results.
- We had started practicing rearing flounder in seawater found around the station in March to learn how to rear marine organisms and to verify equipment design, and have accumulated know-how in breeding. Having also experienced parasites-related deaths and deaths due to the difference of salinity in salt baths※ to eliminate parasites, we have started rearing practice in the mockup tanks in July with improvements.
- In light of rearing practice, we moved to "Rearing test preparation" from September 13. Five series of rearing test tanks and ancillary equipment were newly installed in the controlled areas on station premises and marine organisms (flounder) were also put into the tanks, and therefore, we commenced to rear them for acclimating with seawater from around the power station.

※Salt bath: A way to eliminate parasites in fish by using the difference in salinity in seawater and osmotic pressure in the parasite's body.

<Announced as of September 12, 2022>

Overview of the rearing test

- The functionality of the rearing test tank and other equipment, the state of the filtering system (bacterial colonization) and the flounder have been verified in Preparation Stage ② (rearing test prep). The next stage—the rearing test—will begin on September 30.
- First, samples of flounder and the seawater in the rearing test tank will be taken to establish a baseline. In early October, ALPS treated water will be added to two out of the five series filled with seawater until the tritium concentration is around 1500 Bq/L.
- ALPS treated water will be added to one of the remaining three systems until the tritium concentration is around 30 Bq/L which is the tritium concentration around the discharge tunnel outlet. Additional rearing tests will begin in November.
- The other two systems will be used as rearing test tanks with seawater.

Fukushima Daiichi Nuclear Power Station

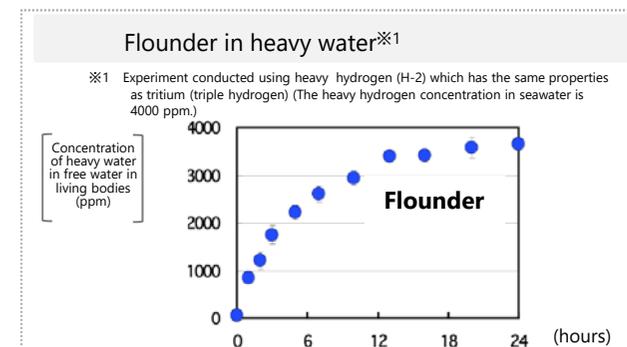
Start of the Marine Organisms Rearing Tests (2/2)



What we hope to prove with the rearing test

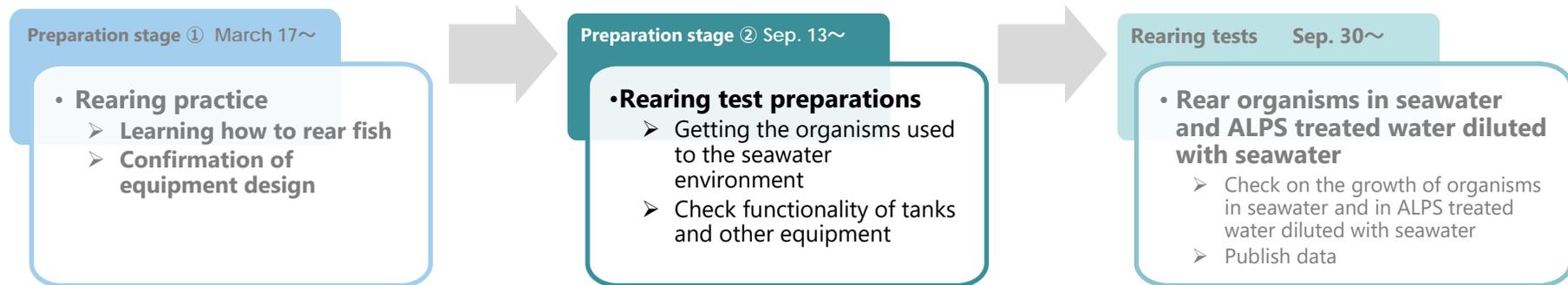
Flounder and other marine organisms will be reared in a tank with ALPS treated water and seawater and in a tank with normal seawater to:

- ① Show how the marine organisms are being reared, thoroughly in an easy way to understand
 - ② Show that "tritium is not concentrated in living bodies and that the tritium concentration in a living bodies will not exceed that of the environment it is reared in", which is in line with the results from previous experiments
- For ①, we will provide a live stream of the rearing tank and write about how the rearing test is going on in the observation diary on our website and on Japanese Twitter. The rearing environment (e.g., water quality, temperature of the water), state of organisms (e.g., changes in the number of organisms), analysis results (e.g., comparisons of the tritium concentration in the live organisms and in seawater) of the marine organisms reared in ALPS treated water diluted with seawater and organisms reared in normal seawater will be summarized and disclosed every month.
 - In addition to having people from the local community and parties concerned visit the test site, we will also have biology experts check on the test as it is ongoing.
 - For ②, there have been many studies domestic and abroad on the behavior of tritium inside a living bodies and the studies have made the following findings. By analyzing and assessing the marine organisms in this rearing test, we will check that the results of these studies can be replicated.
 - The tritium concentration in a living bodies does not exceed that of the environment which it was reared in.
 - The tritium concentration reached an equilibrium after a certain period of time.
 - The results of the rearing test will be published around March 2023 after collecting data for 6 months and assessing the consistency of the results with past findings.



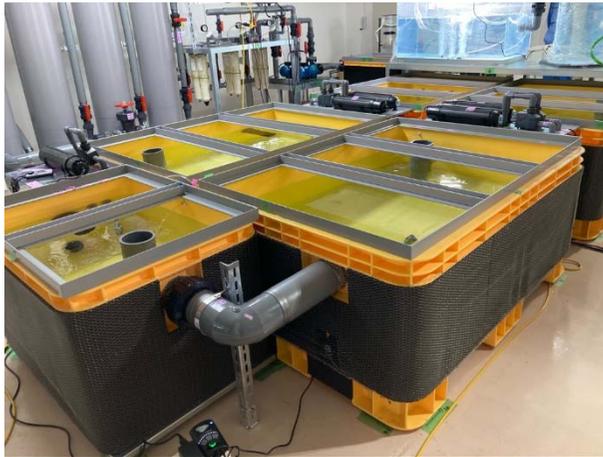
1. Overview of the rearing practice (Preparation stage ②)

- During “Preparation stage ② (rearing test preparation)”, flounders were reared with seawater from around the power station in the rearing test tanks in the controlled areas on station premises for the purpose of examining the functionality of the rearing test tank and filtration systems (bacteria adherence).
- The functionality of the rearing test tank and other equipment, the state of the filtering system (bacterial colonization) and the flounder have been verified. (Refer to the chart below)



Test stage	Details	Deliverables	Period	Location
Preparation stage ② [Rearing test preparations]	<ul style="list-style-type: none"> • Equipment: 5 rearing tank series (Normal seawater) • Target: Approx. 800 flounder (Born in 2022) 	<ul style="list-style-type: none"> • Verified the functionality of the rearing test tank • Verified filtration systems (bacteria adherence) • Brought in flounder and allow them to acclimate • Verified no diseased flounder • Verified procedures for using actual test equipment 	September	On station premises - Inside of the controlled area - - Near the front gate -

1. Overview of Rearing Test Preparation (Preparation ②) (contd.)



Verifying the functionality of the rearing test tank and the filtering system (bacterial colonization)

Checklist for the rearing test tank

- Leaks in the tank and pipes
- Water temperature, flow
- Performance of the UV sterilizer
- pH and chloride concentration

Checklist for the state of the filtering system (bacterial colonization)

- Ammonia concentration
- Nitrite concentration
- Nitric acid concentration
- Solids removal performance



Brought in the flounder and gradually getting them used to the environment



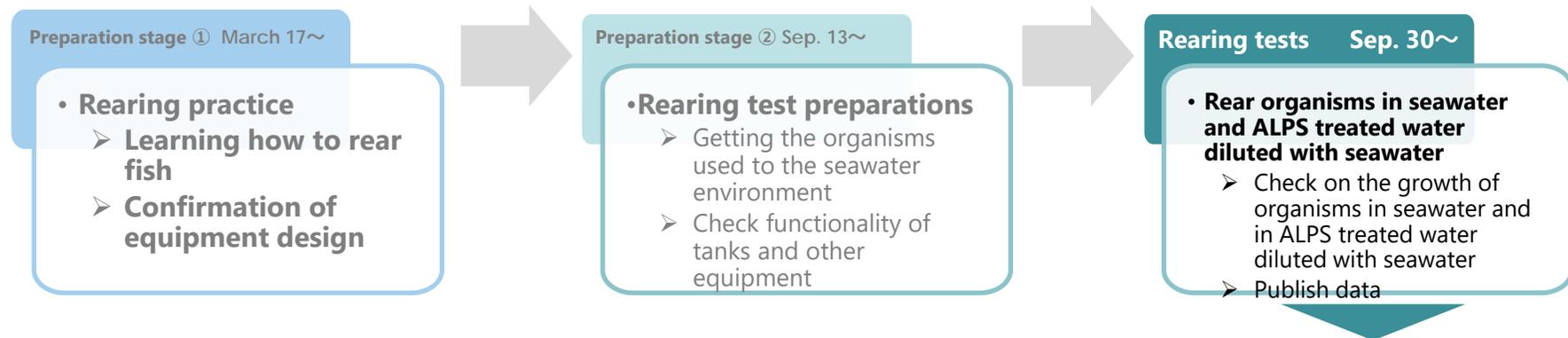
Checking the flounder for disease

2. Start of the Rearing Test

- The functionality of the rearing test tank and other equipment, the state of the filtering system (bacterial colonization) and the flounder have been verified in Preparation Stage ② (rearing test prep). The next stage—the rearing test—will begin on September 30.
- Rearing tests on marine organisms in seawater and ALPS treated water diluted using seawater will be conducted and the growth of the organisms in their respective environments will be compared against each other. The tritium concentrations within the living bodies will be analyzed and assessed.

※1 : To analyze the tritium concentration in marine organisms, the start of rearing will be staggered for each type of organisms

※2 : Tritium concentration will be 1500Bq/L (target value of tritium for ALPS treated water after seawater dilution) and 30 Bq/L (tritium concentration around the discharge tunnel outlet in the radiation impact assessment)

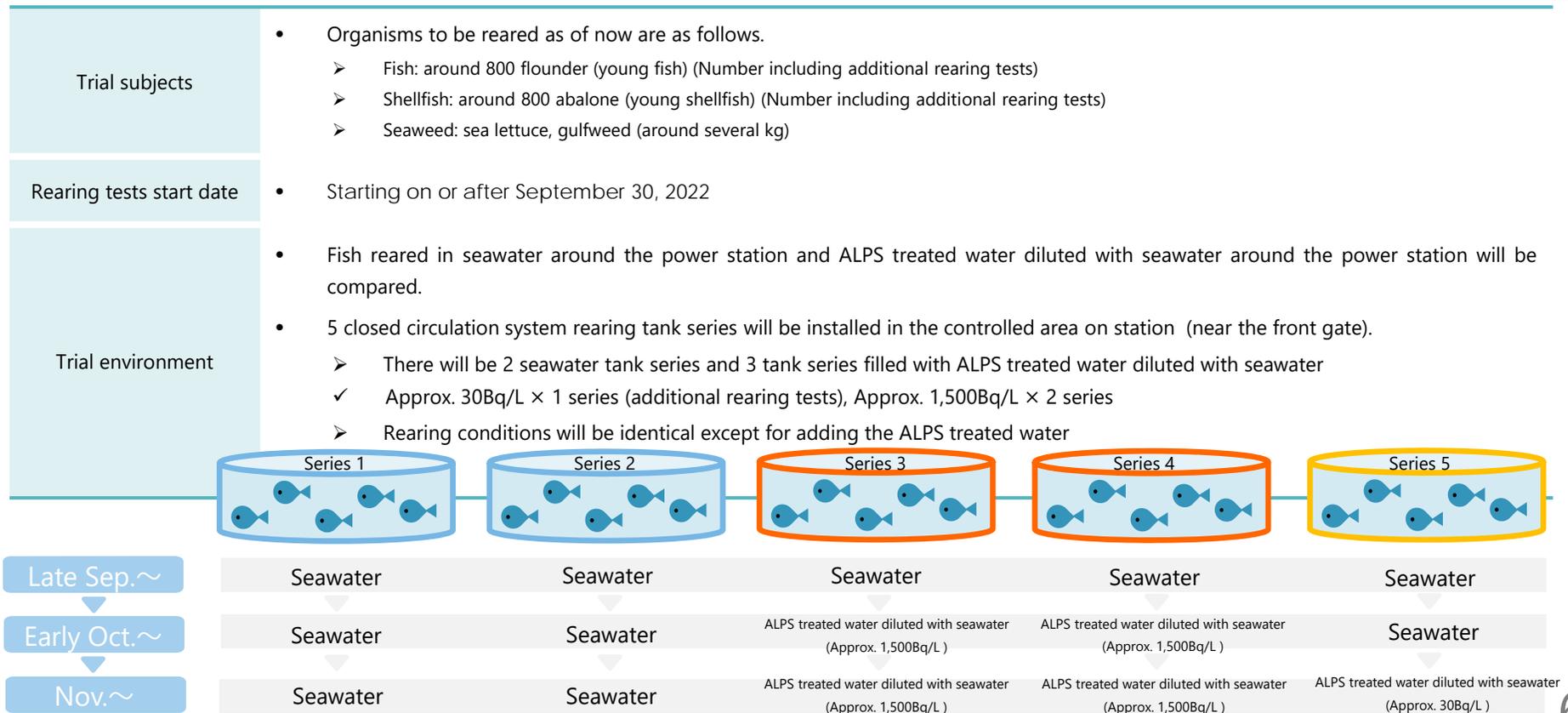


Test stage	Details	Goals	Time frame	Location
Rearing tests	<ul style="list-style-type: none"> ● Refer to the next slide 	<ul style="list-style-type: none"> ● Disclose state of fish and other marine organisms actively and in a transparent manner ● Publish data on radioactivity 	Gradually starting on September 30	On station premises - Inside of the controlled area - - Near the front gate -

3. Overview of the Rearing Test (Before ALPS Treated Water is Discharged Into the Sea)

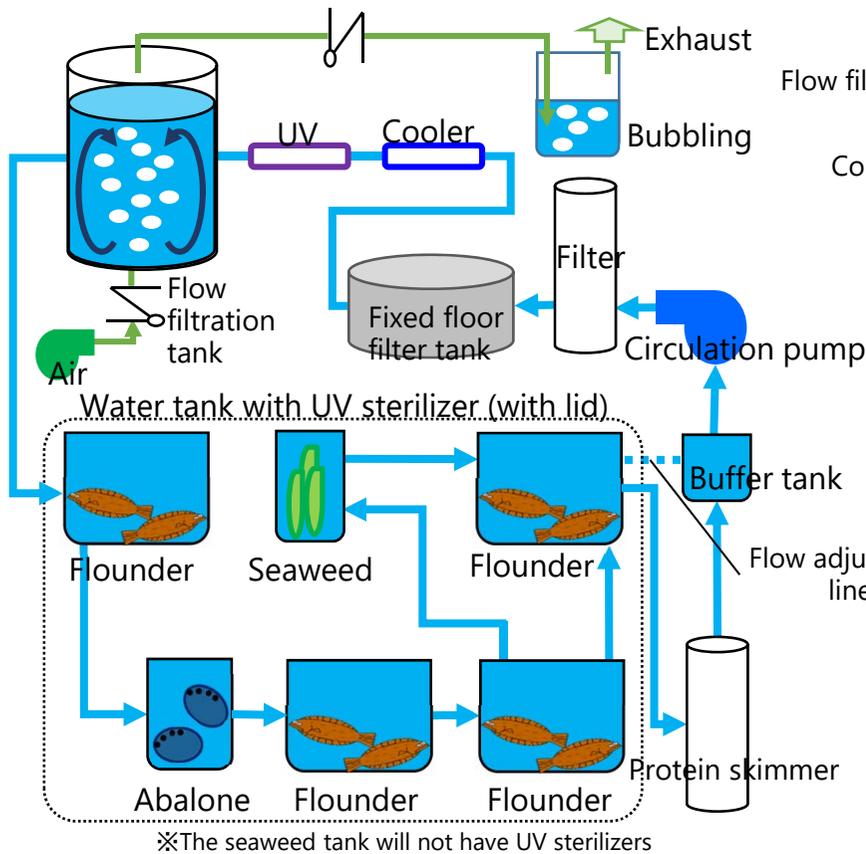


- First, samples of flounder and the seawater in the rearing test tank will be taken to establish the baseline. In early October, ALPS treated water will be added to two out of the five series filled with seawater until the tritium concentration is around 1500 Bq/L, considering that the target value of tritium for ALPS treated water after being diluted with seawater is less than 1500 Bq/L.
- ALPS treated water will be added to one of the remaining three series until the tritium concentration is around 30 Bq/L which is the tritium concentration around the discharge tunnel outlet. Additional rearing tests will begin in November.
- The other two series will be used as rearing test tanks with seawater.

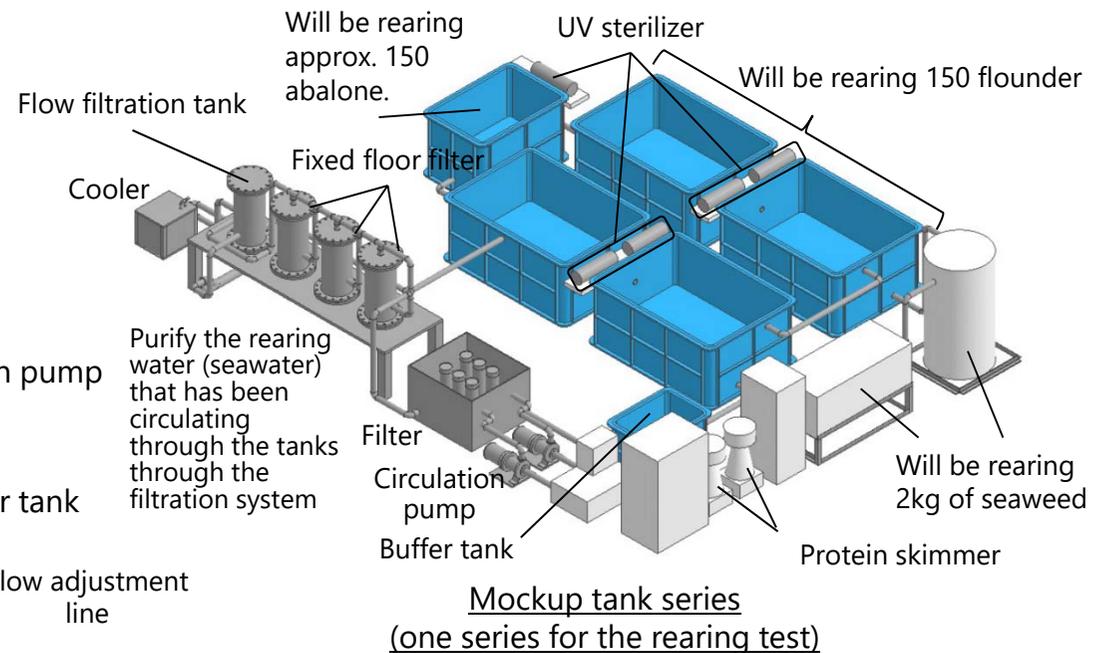


【Reference】 Detailed design of rearing test tanks

- There have been no large issues during rearing practice using mockup tanks, which began in July, so the rearing test tanks will be designed just like the current mockup tanks.



Mockup tank series
(one series for the rearing test)



Mockup tank series
(one series for the rearing test)

Large plastic tank
 Tank for flounder: Size 1.7m×1.2m×0.7m(Outer size), capacity : 1,000L
 Tank for abalone: Size 1.1m×0.8m×0.6m(Outer size), capacity : 400L
 Tank for seaweed:
 Box (placed horizontally): Size 1.2m×0.6m×0.6m(Outer size), capacity : 200L
 Round (placed vertically): Size (diameter) 0.5m×1.5m(Outer size), capacity : 200L

※The actual size and capacity of the tank may be different

4. What We Hope to Prove with the Rearing Test (1/2)

- ① In order to alleviate people's concerns and to cultivate peace of mind, we will rear marine organisms in tanks of seawater containing ALPS treated water and compare them with organism reared in normal seawater and report the results carefully in an easy-to-understand manner.

To be confirmed in the test

- Marine organisms rearing tests will be conducted both in seawater and in ALPS treated water diluted with seawater. The marine organisms in these two environments will be compared via rearing data to confirm there are no significant differences between the two populations.

Information disclosure policy

- For ①, we will provide a live stream of the rearing tank and write about how the rearing test is going on in the observation diary on our website and on Japanese Twitter. The rearing environment (e.g., water quality, temperature of the water), state of organisms (e.g., changes in the number of organisms), analysis results (e.g., comparisons of the tritium concentration in the live organisms and in seawater) of the marine organisms reared in ALPS treated water diluted with seawater and organisms reared in normal seawater will be summarized and disclosed every month.
- In addition to having people from the local community and parties concerned visit the test site, we will also have biology experts check on the test as it is ongoing.



◀ Live stream of the seawater rearing test (for illustration purposes only)

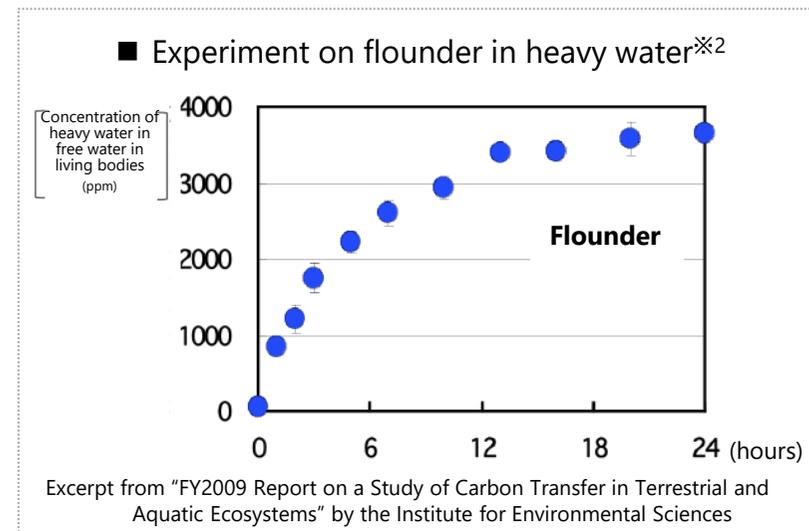
- The normal seawater is in the blue tanks and the ALPS treated water diluted with seawater is in the yellow tanks.
- The layout of the tanks will be changed as needed based on feedback from relevant parties to ensure optimal visibility.

4. What We Hope to Prove with the Rearing Test (2/2)

- ② Based on the results of many studies domestic and abroad on the behavior of tritium, data for this test will first be gathered for 6 months to show that "tritium is not concentrated in the living bodies and that the concentration of tritium in living bodies does not exceed that of the rearing environment" as demonstrated in past tests results.

Results of experiments domestic and abroad

- The tritium concentration in a living bodies does not exceed that of the environment which it was reared in.
- The tritium concentration reached an equilibrium after a certain period of time.
 - ※1 Tritium in living bodies is either free water tritium (FWT) or organically bound tritium (OBT). Studies have been conducted domestically and abroad for both.
 - ※2 This experiment was conducted using heavy hydrogen (H-2) which has the same properties as tritium (H3) (The heavy hydrogen concentration in seawater is about 4000 ppm.)
 - Free water tritium (FWT): Tritium that exists in the form of water in living bodies
 - Organically bound tritium (OBT): Tritium that is organically bound with carbon and other molecules in living bodies



To be confirmed in the rearing test

- The tritium levels in the flounder, abalone and seaweed reared in the ALPS treated water diluted with seawater (tritium concentration of approx. 1500 Bq/L) will be analyzed and assessed* to confirm that tritium levels will reach equilibrium after a certain amount of time, and that the tritium concentration at equilibrium doesn't exceed that of the rearing environment.
 - It will also be confirmed that the tritium levels of marine organisms that have reached the tritium equilibrium will fall once they are moved to seawater only tanks .
- ※3 OBT data will be collected over 6 months and assessed for conformity with past data to confirm that OBT levels do not exceed that of the rearing environment.

5. Schedule for Publishing Data Obtained in the Rearing Tests



- The data obtained in the rearing test will be published every month once preparations are complete.
- In reaching a milestone with the rearing test, the assessment will be published around March 2023. The assessment will analyze the measurement results below and check for consistency with past findings.
 - Tritium measurements for all organisms reared (including those reared in normal seawater) ※1
 - Assessments from experts (including visual assessments)
- Seaweed analysis, assessment and publishing of results will be conducted separately in time with the collection and growing of seaweed.

※1 Rearing practice has found that among the marine organisms, only flounder can be reared for a long time in a closed circulation environment, which experts agree on. As such, OBT analysis and assessment will only be conducted for flounder.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	
Schedule	▼Start rearing test (collect baseline data for flounder, start streaming live camera footage of the tanks 24/7) ▼Add ALPS treated water (seawater with a tritium concentration of about 1500Bq/L) ▼Start rearing abalone ▼Start additional rearing test (Tests in ALPS treated water diluted with seawater (Approx. 1,500Bq/L))							
Content to be published		▼Publish data	▼Publish data	▼Publish data	▼Publish data	▼Publish data	▼Publish data	▼Assess
			▼Tritium trends in flounder and abalone			▼ Tritium trends in flounder and abalone (additional tests)		

※Content to be published and publishing timing are subject to change based on progress made in the rearing tests.

※Seaweed will be reared during their growing seasons (Fall to winter for sargassum fulvellum, next spring onwards for sea lettuce)

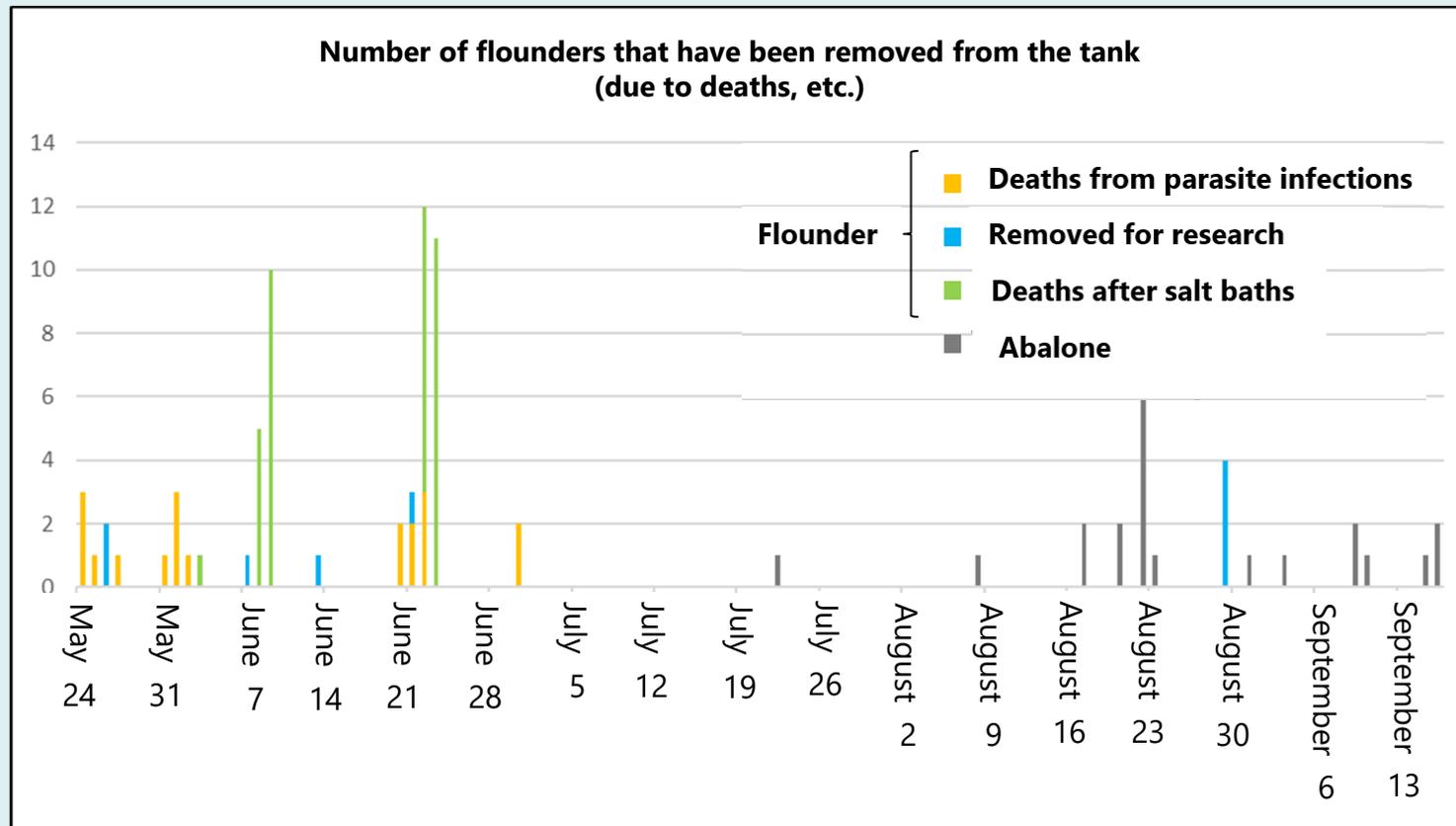
6. Schedule

Test stage	Location	FY2021		FY2022				FY2023	
		3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q
Preparation stage ①-1: Rearing preparation tank Preparation stage ①-2: Mockup tank (rearing practice)	On station premises - Outside of the controlled area - - Near the contractor buildings -				Learn how to rear marine organisms in the rearing preparation tank, grow bacteria in a separate tank	[Now] Learn how to rear marine organisms in the mockup tank, grow bacteria in the mockup tank			
Preparation stage② (Rearing test preparation)	On station premises - Inside the controlled area - - Near the front gate -		Hatch and grow founder for the rearing tests 【Hatching】		【Carrying onto premises】		Check rearing tests equipment functionality, start getting the flounder used to the environment, check for diseases, check on bacteria colonization		
Rearing tests							Rearing tests	Disclose data obtained in rearing tests	

The schedule is subject to change based on progress made

【Reference】 Rearing status of marine organisms

Tank series	Classification	Changes in number of organisms	
		Number of flounder removed from the tank	Number of flounder left (as of Sep. 16, 2022)
1	Normal seawater	Flounder : 64 (19 deaths due to parasites, 9 for research, 36deaths after salt baths) Abalone : 21	Flounder : 76 Abalone : 9



※Sea lettuce (annual herb) that started rearing practice in August was found to have died standing after maturity.

【Reference】 Updates on marine organisms rearing on the TEPCO's website and on Twitter



<Marine Organism Rearing Log>

9 AM, September 14, 2022
Weather: Sunny
Water temperature: 17.9°C

Following from yesterday, we have carried in about 400 flounders into the tanks in the controlled area. The tanks for rearing test is classified in yellow and blue tanks. The yellow tanks are planned to be added ALPS treated water and the blue ones are to be filled with regular seawater only for comparison. Now, we are reporting rearing test status on this rearing log from next report.



【TEPCO's website】

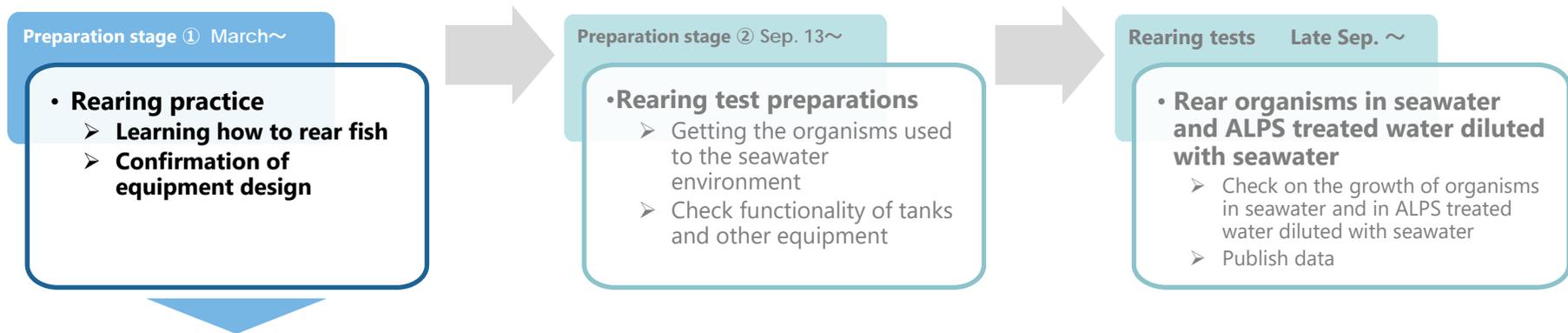


【Twitter】 (in Japanese only)

- Since March 17, we have been updating the public on marine organisms rearing on the TEPCO's website and on Twitter.
 - Website : <https://www.tepco.co.jp/en/hd/decommission/information/newsrelease/rearing/index-e.html>
 - Twitter : <https://twitter.com/TEPCOfishkeeper> (in Japanese only)

【Reference】 Overview of the rearing practice (Preparation stage ①)

- During Preparation stage① (Rearing practice), rearing practice tanks and mockup tanks on station premises (outside of the controlled area) were used to rear flounder, abalone, and sea lettuce using seawater from around the power station in order to acquire rearing know-how and perform detailed examinations of the design of rearing test tanks.
- During rearing practice with mockup tanks we made improvements to review tank design considering the elimination and reduction of parasites and to get rid of the parasites, and confirmed that the improvements are effective. (Refer to the chart below)



Test stage	Details	Deliverables	Period	Location
Rearing preparation tank	<ul style="list-style-type: none"> ● Equipment: 1 rearing tank series (Normal seawater) ● Target : Flounder 140 flounder 	<ul style="list-style-type: none"> • Learn how to rear marine organisms 	March ~ July	On station premises - Outside of the controlled area - - Near the contractor buildings -
Rearing practice Learn how to rear marine organisms for Rearing test Mockup tank	<ul style="list-style-type: none"> ● Equipment: 1 rearing tank series (Normal seawater) ● Target : Flounder, abalone, seaweed (sea lettuce) Flounder will be transported from the rearing preparation tank (approx. 80), approx. 30 abalone, around 2 kg of seaweed 	<ul style="list-style-type: none"> • Learn how to rear marine organisms • Finalize detailed design of rearing test tanks • Exact requirements necessary for rearing equipment other than tanks • Create rearing and operating procedures 	July ~ September	On station premises - Outside of the controlled area - - Near the west gate -

【Reference】 Leveraging the know-how and experience gained in rearing practice

- During rearing practice, we enlisted the assistance of experts from outside the company to train employees how to rear flounder while also managing water tank/water quality and checking the development of flounder and abalone, etc. on a daily basis.

Opinions received from external experts

- It's impossible to completely eliminate parasites, but the equipment, methods, and parasite countermeasures employed during current rearing training are not inferior, so you should continue to do just what you're doing. However, since we anticipate that the period of rearing will be very long, an issue to address is how to maintain this level of management into the future.
 - You're performing the basics for marine organisms rearing and there are no problems. If you aim to rear for a longer period of time you will have to be further innovative in regards to methods for maintaining dissolved oxygen, and the flow in water tanks and filtration tanks.
- Based on our experience gained in use of the rearing practice tanks, we made improvements to review tank design considering the elimination and reduction of parasites and to get rid of the parasites (bathing the flounder in salt baths) when they first come into the facility.

Primary parasite countermeasures

- [Measures to prevent parasites from getting in]
Salt baths are implemented before new fish are put in the tanks in order to prevent parasites from getting into the mockup tanks
 - [Measures to prevent parasites from spreading]
UV sterilizers have been installed in each tank to eliminate parasites (including eggs) before they can spread to other water tanks
 - [Measures for detecting parasites]
Random inspections of flounder are conducted (in order to find parasites early), in addition to searches for the eggs of parasites in rearing practice tanks, and additional countermeasures are deliberated as necessary
- Based on the knowledge gained from the mockup tank we have revised operating methods to enable us to maintain suitable water quality for the rearing of abalone, such as stipulating conditions for filter materials and flow speed.
 - Further improvements will be made during the rearing test preparation phase as we move towards actual rearing tests.